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$$\therefore \text{ the required average} = \frac{2v\int_0^{\pi} \sin\tfrac{1}{2}\theta d\theta}{\int_0^{\pi} d\theta} = 4v/\pi.$$

Also solved by *G. B. M. ZERR.*

MISCELLANEOUS.

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56. Proposed by S. HART WRIGHT, A. M., M. D., Ph. D., Penn Yan, N. Y.

In latitude 40° N. $=\lambda$, when the moon's declination is 5° 23′ N. $=\delta$, and the sun's declination 9° 52′ S. $=-\delta'$, how long after sunset will the cusps of the moon's crescent set synchronously, the moon having recently passed its conjunction with the sun ?

[NOTE. Problem 56 is identical with problem 54, and need not be here reproduced. See January number, pages 27 and 28, for two solutions. EDIROR.]

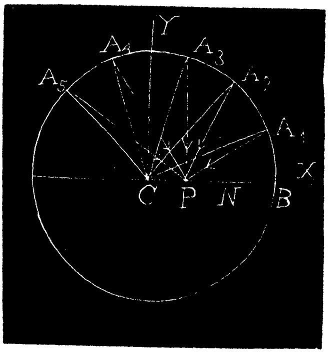
57. Proposed by GEORGE LILLEY, Ph. D., Professor of Mathematics, University of Oregon, Eugene, Ore.

A particle is placed very near the center of a circle, round the circumference of which n equal repulsive forces are symmetrically arranged; each force varies inversely as the mth power of its distance from the particle. Show that the resultant force is approximately $\dfrac{m_1 n(m-1)}{2r^{m+1}} \times CP$, and tends to the center of the circle, where m_1 is the mass of the particle, CP its distance from the center of the circle, and r the radius of the circle.

I. Solution by the PROPOSER.

Let the particle be at P, and C the center of the circle. Suppose the forces to be at A_1, A_2, ... $CP=x$, and $\angle A_2CB=\theta$. Then $\angle A_1CA_2=\angle A_2CA_3 = \ldots\ldots = 360°/n=\beta$, say. Draw A_2N at right angles to CB. Consider the force at A_2. Then,

$$X=[m_1/(A_2P)^m]\cos A_2PN=[m_1(r\cos\theta-x)]/(r^2+x^2-2rx\cos\theta)^{\frac{1}{2}(m+1)}.$$



Let $m_1/r^{\frac{1}{2}(m+1)}=M$. Then, since x is small, neglecting terms containing higher powers of x than the first, we have

$$X=M\left[r^{\frac{1}{2}(1-m)}\cos\theta+\frac{\cos2\theta.x.r^{-\frac{1}{2}(m+1)}}{2} + \tfrac{1}{2}(m-1)xr^{-\frac{1}{2}(m+1)}\right].$$

To obtain the total force on P along X take the sum of n such expressions for all values of θ from $\theta=\alpha$ to $\theta=\alpha+(n-1)\beta$. Hence,